The 2025 World Congress on
Advances in Structural Engineering and Mechanics (ASEM25)
BEXCO, Busan, Korea, August 11-14, 2025

Three-dimentional dynamic analysis between Hypertube Express (HTX) and the guideway through vehicle-bridge interaction

Seung-Min Baek[1], Seunghwan Park[2], Man-Cheol Kim[3], Phill-Seung Lee[4], and Hyung-Jo Jung[5*]

[1,5]Department of Civil and Environmental Engineering, KAIST, Daejeon 305-600, Korea,
[2,4]Department of Mechanical Engineering, KAIST, Daejeon 305-600, Korea
291 Daehak-ro, Yuseong-gu, Daejeon 34141, Republic of Korea
[3]Korea Railroad Research Institute, Gyeonggi-do 16105, Korea
[5]hjung@kaist.ac.kr

ABSTRACT

This paper presents the improved algorithm for three-dimensional (3D) dynamic analysis between a Hypertube Express (HTX) and a guideway and analyses the dynamic characteristics of each system. The HTX, which uses superconducting electromagnets, cruise at ultra high speed in a magnetically levitated state with minimal frictional resistance by utilizing the induction and repulsion principles of the levitation coil and induction coil of the guideway. The interaction force between the HTX and the guideway is affected by the displacement of the HTX, the displacement of the guideway, and the irregularity, and each system shows different dynamic characteristics from the existing train and bridge interaction systems. Therefore, the design and safety issues are discussed based on the results of the dynamic interaction between the HTX and the guideway. Therefore, in this study, the system matrix and interaction force of the HTX and the guideway are calculated to numerically analyze the three-dimensional dynamic behavior. The superconducting electromagnets of the HTX are designed with nonlinear equivalent stiffness based on the cruising speed and displacement, and the guideway is modeled based on shell finite elements considering the irregularity affecting the interaction, and accurate and realistic analysis results are presented. Through the results of the improved algorithm, the dynamic characteristics of HTX and guideway, such as ride comfort and dynamic amplification factor (DAF), are analyzed, providing a basis for the initial design.

This research was supported by the Basic Science Research Program through the National Research Foundation of Korea (NRF), funded by the Ministry of Science and ICT (RS-2023-00280972).